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UTILIZING ERTS IMAGERY TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND SOIL MOISTURE LEVELS

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16. Abstract

The delineation of soil associations and detection of drainage patterns, erosion and sedimentation through the use of ERTS imagery are shown. Corn blight and corn virus could not be detected from ERTS and detection of forest composition was at a very low probability.

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Preface

This report covers progress over the March-September period of 1973 and includes work on soil association identification, detecting plant diseases, soil moisture and drainage patterns and classifying forestry types.

Identifying large soil associations from ERTS imagery is possible and has been accomplished. Detecting plant diseases (corn virus and blight) may be done from low altitude imagery but is not possible from ERTS. Drainage patterns and sedimentation are easily distinguished from ERTS imagery and lower altitude aircraft imagery provides much greater detail of these areas. Predicting forest species from ERTS imagery has been at a low probability.

Soil associations, drainage patterns, erosion and sedimentation may be detected from space imagery.

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INTRODUCTION

Progress on the utilization of ERTS data to detect soil differences, plant diseases, soil moisture, drainage patterns and classify forest stands during March-September is presented in the following sections.

DELINEATION OF SOIL ASSOCIATIONS

Aircraft imagery (25,000 ft.) of the more disected area of Obion County has been examined and where the ground has been turned (void of vegetation) it is possible to delineate soil differences even at the series level. However, this has been done by previous work at LARS as well as our Themis studies.

The ERTS imagery is better for the delineation of large soil associations and gives a better picture of drainage patterns within the area. Imagery of Dyer County in Northwest Tennessee and imagery from Southwest Tennessee and Northwest Mississippi were examined and the separation of the Memphis soil association from the Delta is clearly visible throughout West Tennessee and for all of Mississippi shown on the imagery (Figures 1 and 2).

Additional information on soil delineations in Obion County clearly outline Delta soils, Memphis soil associations, Reelfoot Lake and the Mississippi River (Figure 3). Through the use of data slicing techniques the boundaries among these objects is shown more clearly (Figure 4).

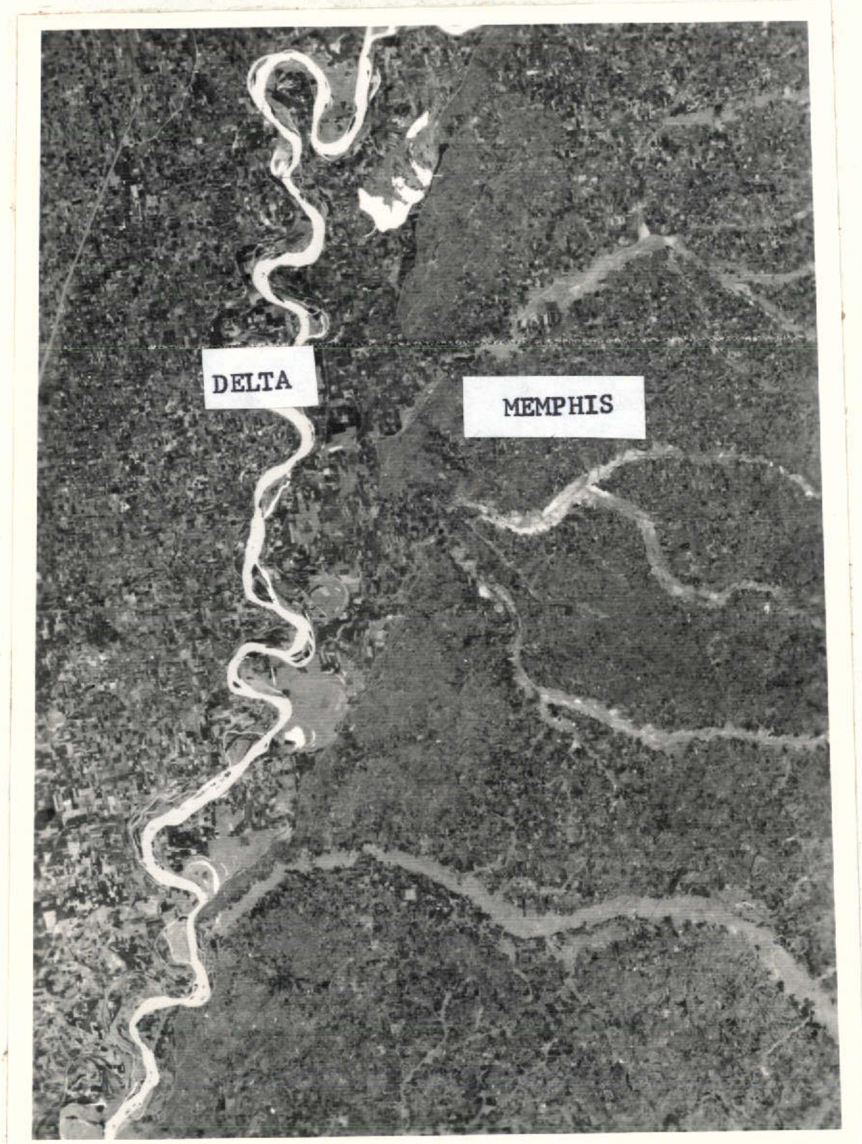


Figure 1. ERTS-1 imagery of October 1, 1972 showing separation of the Memphis and Delta soil associations in West Tennessee.

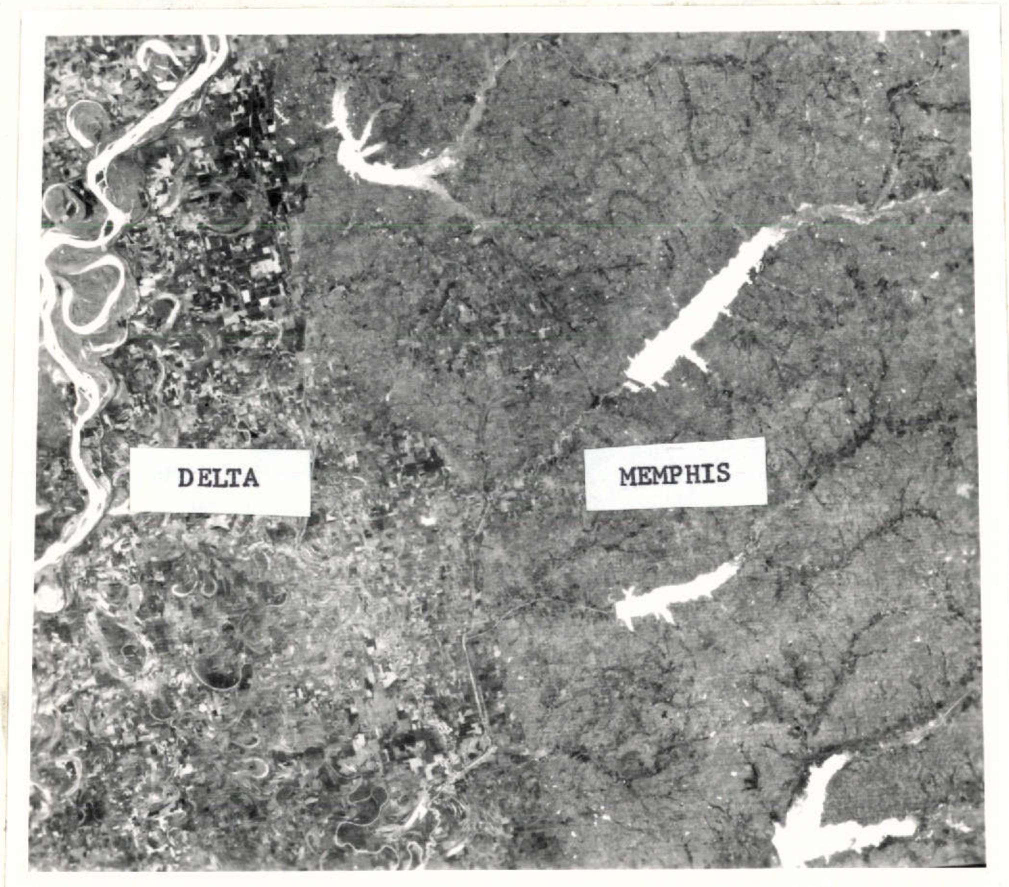


Figure 2. ERTS-1 imagery of October 1, 1972 showing separation of the Memphis and Delta soil associations in the Mississippi Delta South of Memphis, Tennessee.

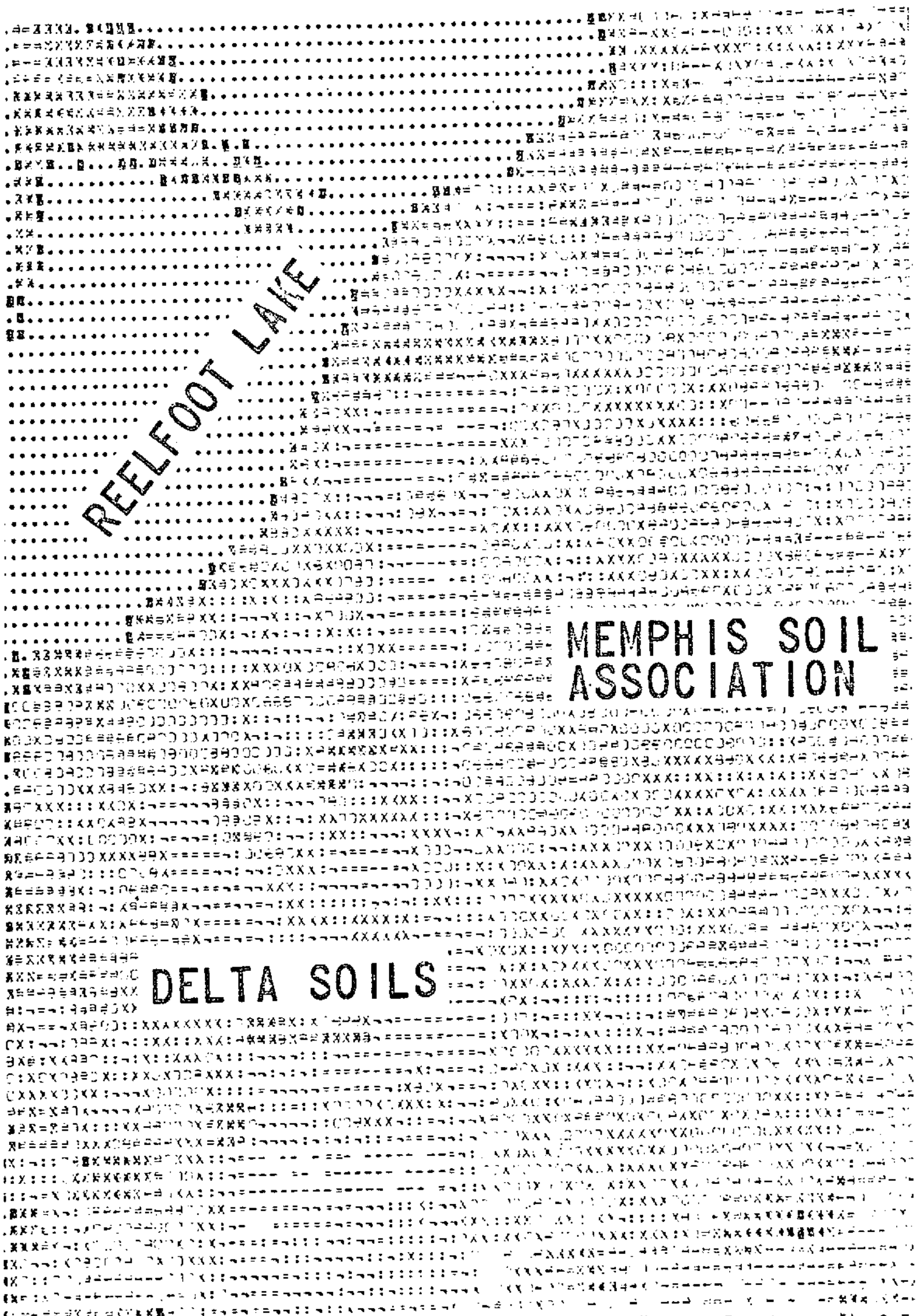


Figure 3. Full scale computer printout from Channel 7 of October 1, 1972 ERTS imagery showing Reelfoot Lake, Delta and Memphis soil associations in West Tennessee.

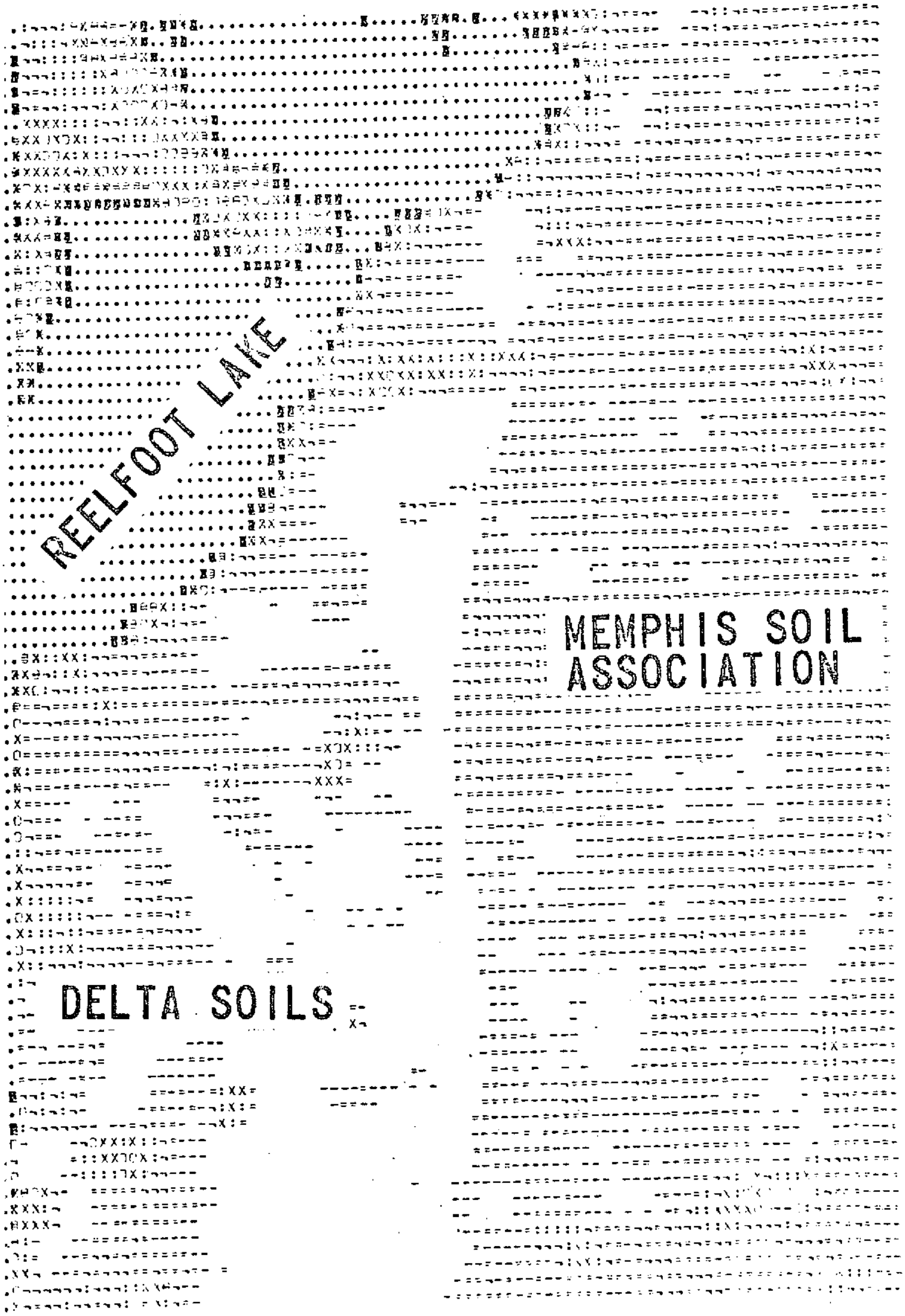


Figure 4. Computer printout from Channel 7 of October 1, 1972 ERTS imagery using data slicing technique to more clearly separate Reelfoot Lake, Delta and Memphis soil associations in West Tennessee.

DETECTING SOIL MOISTURE, DRAINAGE PATTERNS, EROSION AND SEDIMENTATION

Upper Middle Tennessee

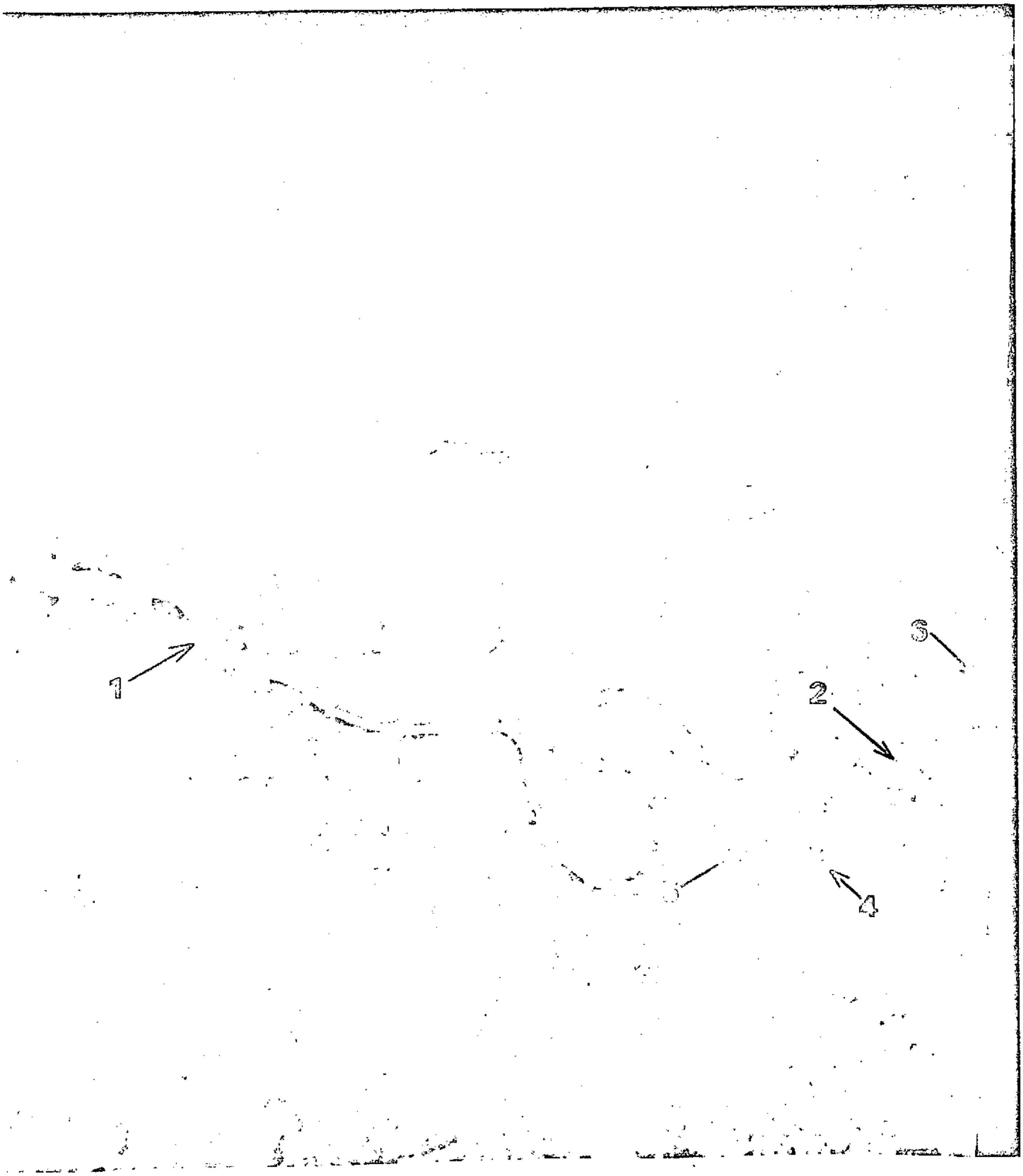
The 5 November 1972 band-7 scan of Upper Middle Tennessee, including the Nashville area, was analyzed visually and by computer printout of optical density data. The Cumberland River is shown in Figure 5, Point 1. In the visual analysis of the Nashville vicinity, small, mostly rectangular-shaped areas varied in gray density from a light, almost white color to a very dark, almost black color (Figure 5, Point 2); but most of the immediate area surrounding the downtown area is a light gray. However, several areas are very dark in texture (Figure 5, Points 4, 5, and 6). In relating the dark areas to a map of Nashville, they were found to correspond to parks and golf courses. The dark areas on the image, therefore, represent open, grass-covered areas.

The computer printouts of the ERTS imagery of the Nashville area were difficult to analyze. Although the computer printouts did define the optical densities of each small increment of the imagery, they enlarged the imagery to such an extent that some of the definition and clarity was lost. However, a lake, Marrowbone Lake (Figure 5, Point 3) was clearly identified by the printout given in Figure 6.

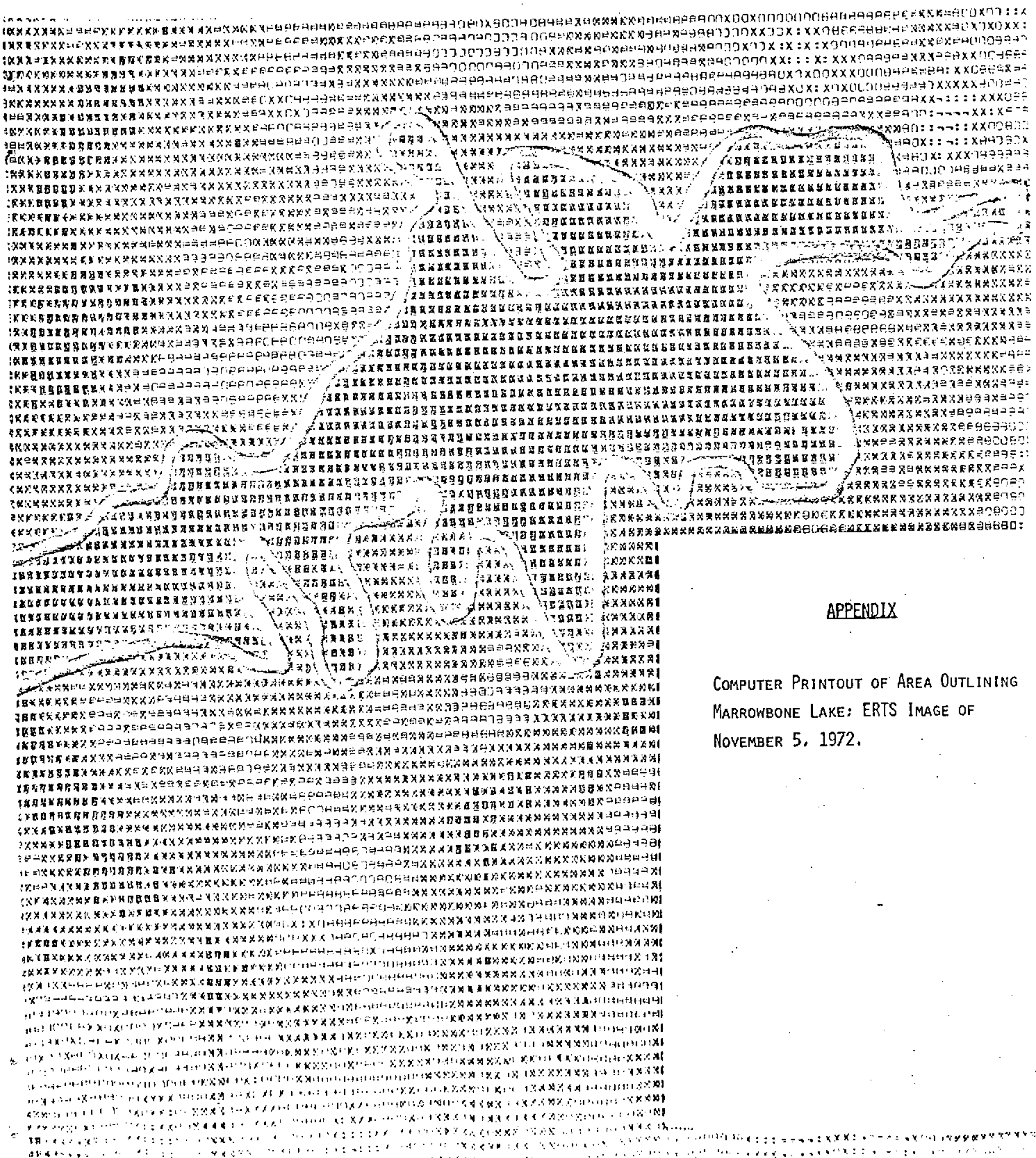
The lake appeared dark on the computer printout of Figure 2 because the computer printed a negative of the ERTS image. Had a positive been printed, this area would have appeared light on the ERTS imagery, which corresponds to previous findings where water was shown in white tones.

Upper West Tennessee

Photographic enlargements (4X) of the 13 September 1972 band-7 image of the Mississippi River and Upper West Tennessee were analyzed. Low-level



ure 5. Upper Middle Tennessee by ERTS-1 Satellite on 5 November 1972. Cumberland River, point 1; Downtown Nashville, 2; Marrowbone Lake, 3; Richland Golf Course, 4; McCabe Golf Course, 5; and Shelby Park, 6.



APPENDIX

COMPUTER PRINTOUT OF AREA OUTLINING MARROWBONE LAKE: ERTS IMAGE OF NOVEMBER 5, 1972.

Figure 6. Computer Printout of Area in Vicinity of Nashville, Tennessee on 5 November 1972 Outlining Marrowbone Lake.

aerial photographs and a 1965 soil survey of Lake County were excellent sources with which to compare the ERTS imagery. The shorelines of both Reelfoot Lake and the Mississippi River are very distinct on the ERTS image. Small inlets of water located adjacent to the Lake and the river can be readily identified. Some of the islands which are mapped on the 1965 Mississippi River Soil Survey do not appear on the ERTS image; also, some of the islands are not of the same shape. These differences are most probably due to changes in the sizes, shapes, and even the locations of the islands between 1965 and 1972.

This is an excellent example of how ERTS imagery could be used in analyzing erosion and sedimentation along rivers and in rapidly mapping changes in river channels. This could provide up-to-date information which could be of great help in updating river navigation charts and maps. Also, since ERTS imagery periodically covers such large areas, its imagery could be valuable in making rapid gross estimates of flood damage over a large area.

Lower West Tennessee

A NASA-Houston photographic mission of the West Tennessee Experiment Station at Jackson and the Ames Plantation at Grand Junction was flown on 4 May 1973. The aerial photographs provided have been most valuable in analyzing the ERTS imagery of these target areas. Computer printouts, based on ERTS imagery optical density values, delineated from the surrounding terrain, rivers and associated wetlands (Forked Deer and Wolfe Rivers), a

bottom-land field area (125 acres) of the West Tennessee Experiment Station, Interstate 40 Highway at Jackson, and some field areas at the Ames Plantation having at least 150 acres cultivated as a unit. Techniques for delineating by digital computer printouts smaller field areas, the imagery of which has varying optical densities, have not been perfected.

DETERMINING FOREST SPECIES COMPOSITION AND VOLUME CLASSIFICATION

Using NASA aircraft coverage from 28 March 1973 for a portion of Polk County, species composition and volume classification were predicted. Using the imagery taken with film 2402 with a #25 filter, stands were classified as pine, hardwood or mixed based on their textural characteristics. The imagery taken on film 2424 with a #89B filter was divided into cells which had an area on the ground of approximately 10 acres. Each cell was assigned one of five volume classes based on its tonal characteristics on this imagery.

A small number of cells were selected for ground location and inventory with a cluster of nine BAF 10 prism points.

Table 1 presents a comparison of the imagery-based prediction of species composition and the ground-based assignment.

Table 1. Comparison of predicted species composition from 2402 film with #25 filter and actual species composition for 55 plots examined on the ground.

Ground-based assignment of species composition	Imagery-based prediction of species composition		
	Hardwood	Pine	Mixed
Hardwood	6	13	9
Pine	8	1	7
Mixed	4	3	4

A similar comparison will be made between imagery-based volume predictions and ground-based predictions upon completion of the inventory tabulation for the ground plots.

The results in Table 1 indicate a low probability of correctly predicting species composition from this type of imagery. If species prediction were reliable, the majority of the observations would be on the major diagonal of the table. At least part of this misclassification can be attributed to interpretation of yellow-poplar stands as pine stands. Both occur in homogenous stands and have conical shaped crowns, whereas other hardwoods occur mixed stands and have spherical crowns. Also, at the time of flight, yellow-poplar was in leaf while most other hardwoods were devoid of foliage.

NEXT REPORTING PERIOD

The next report will be the final report due on December 1. Additional work planned for that report includes further analysis of aircraft imagery, more data slicing and verification in ERTS imagery that will provide more insight to the original objectives of the study.

CONCLUSIONS

This report along with previous reports on this project clearly illustrate the delineation of soil associations through the use of ERTS imagery. The detection of drainage patterns, erosion, and sedimentation are also clearly shown.

Corn blight and virus were not detected from ERTS imagery even though this has been accomplished with aircraft imagery.

Identifying forest specie composition had a low probability level although it has been done using low altitude aircraft imagery.